A Comparison of Splitting Techniques for the Isentropic Euler Equations

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Mots-clés : low Mach, discontinuous Galerkin spectral element, IMEX Runge-Kutta

Solving the isentropic Euler equations at low Mach numbers is a challenging endeavor as they are inherently stiff. For the efficient solution there exist various approaches. One of those approaches are splitting techniques, relying on the splitting of the equations in stiff and non-stiff parts. The idea is to use an explicit time stepping procedure only for the non-stiff parts. The stiff parts are integrated in time with an implicit time stepping procedure avoiding the strong acoustic time step restriction and leading to IMEX schemes. In [1] we have shown the applicability of the high-order discontinuous Galerkin IMEX framework to low Mach number flows with a specific splitting.
In this talk we will illustrate a generalized form of splitting schemes, introduced in [2], for which the asymptotic preserving property can be shown for a discontinuous Galerkin framework. It will be shown that the ideas of splitting the isentropic Euler equations by [3], [4] and [5] fit in the generalized form.
The implementation of the different splitting techniques in one code framework allows to investigate their accuracy and efficiency. Regarding the accuracy almost no differences between the schemes are observed, but considering efficiency the splittings differ. This motivates the modification of the splitting presented in [3]. The modifications will be presented and assessed concerning accuracy and efficiency. It will be shown that the splitting by [4] and one of the modifications of [3] outperform the other splittings for the considered multidimensional test cases.

Références

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